





# Cell Division—Mitosis Notes

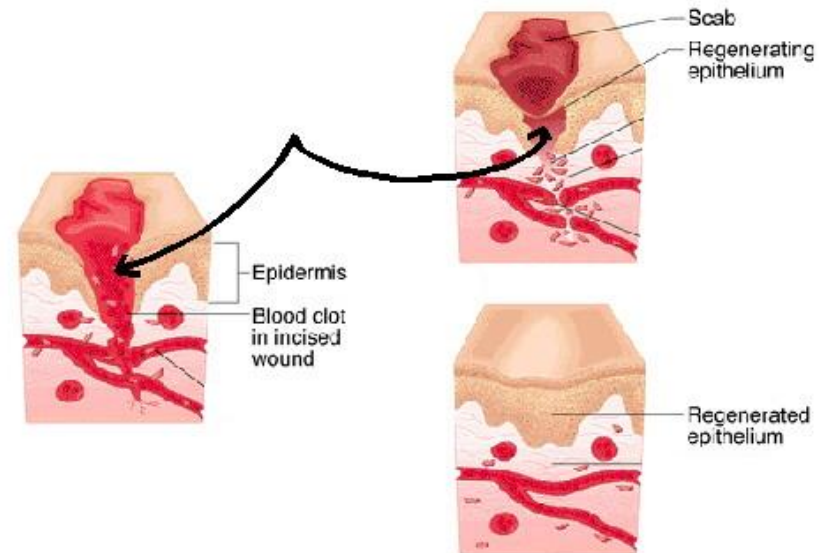
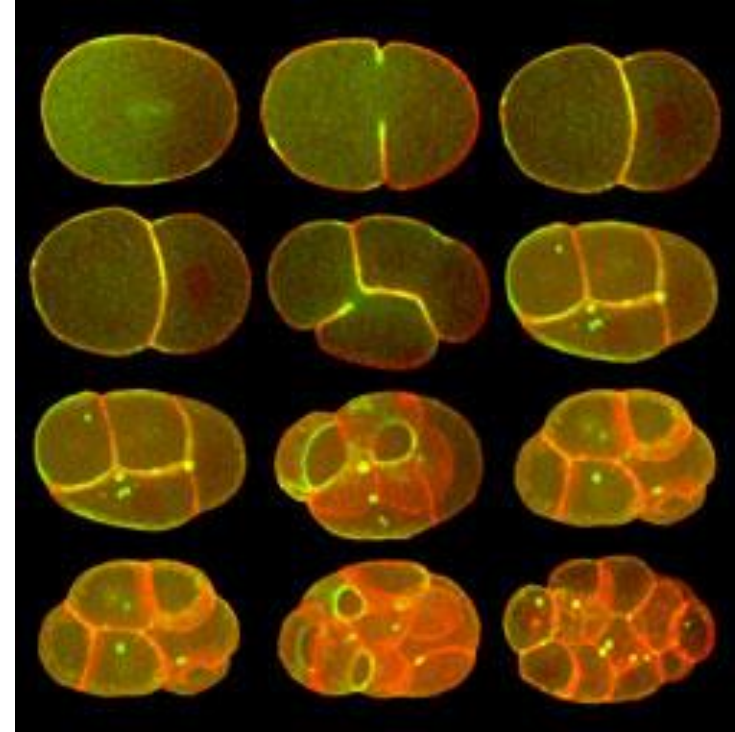
**Cell Division** — process by which a cell divides into 2 new cells

- Why do cells need to divide?

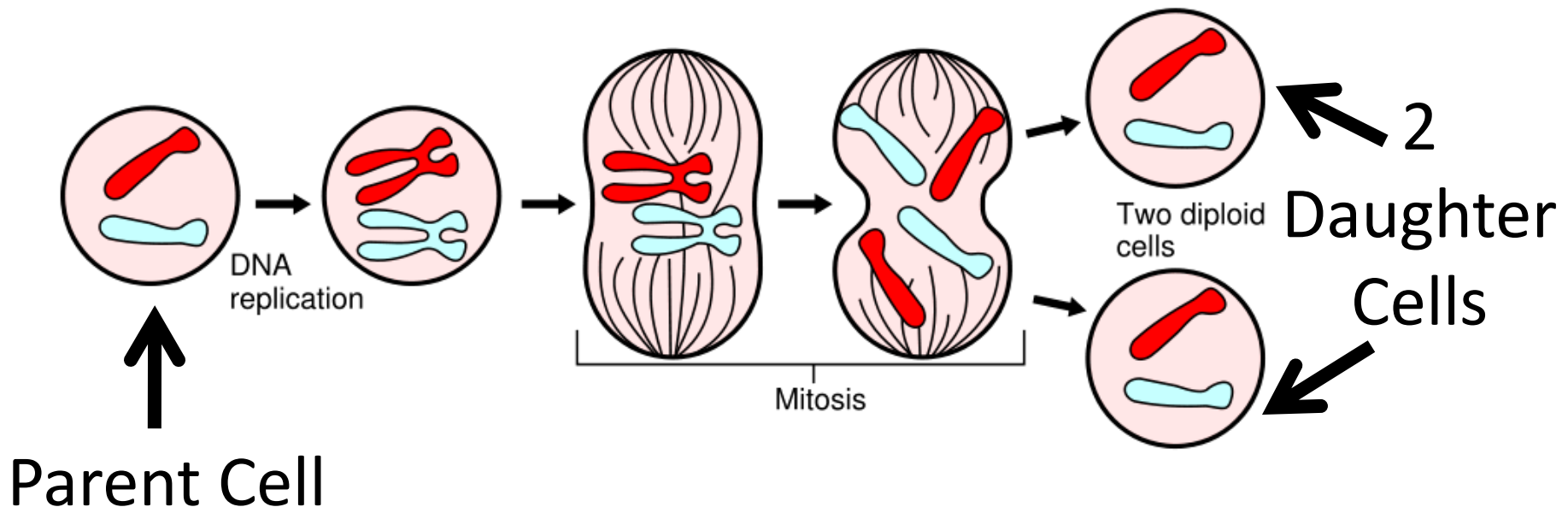
1. Living things grow by producing more cells, NOT because each cell increases in size

2. Repair of damaged tissue

3. If cell gets too big, it cannot get enough nutrients into the cell and wastes out of the cell



- The original cell is called the parent cell; 2 new cells are called daughter cells
- Before cell division occurs, the cell replicates (copies) all of its DNA, so each daughter cell gets complete set of genetic information from parent cell
- Each daughter cell is exactly like the parent cell – same kind and number of chromosomes as the original cell



- Many organisms, especially unicellular organisms, reproduce by means of cell division – called asexual reproduction – Ex: bacteria

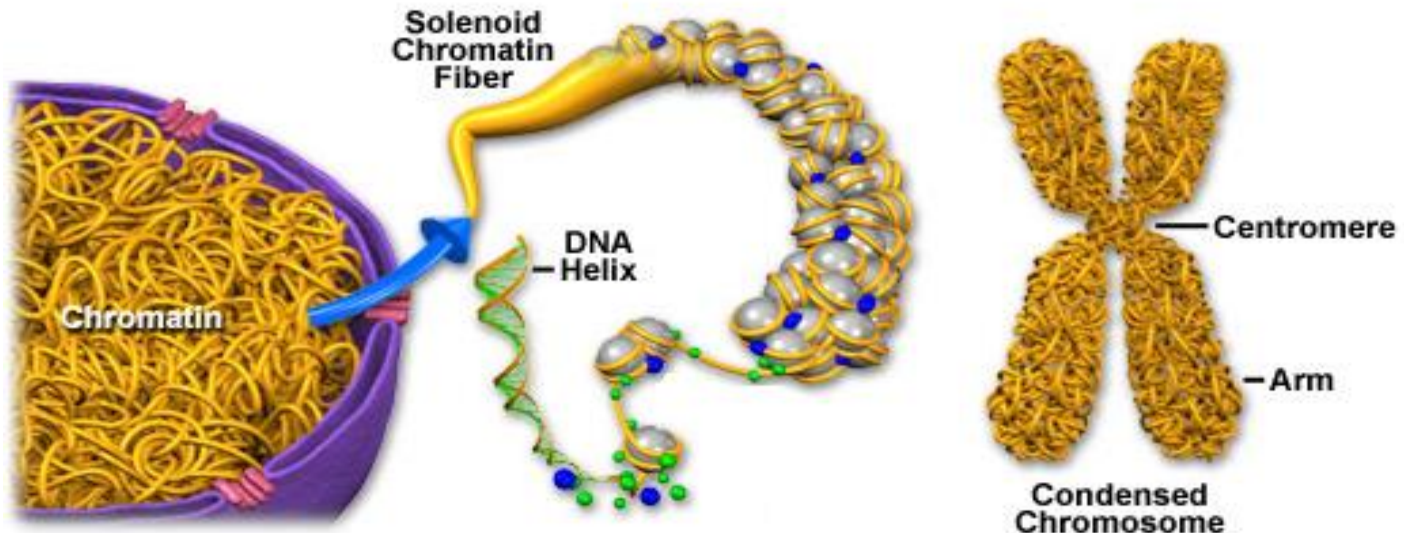


# DNA

- DNA is located in the nucleus and controls all cell activities including cell division
- Long and thread-like DNA in a non-dividing cell is called chromatin
- Doubled, coiled, short DNA in a dividing cell is called chromosome

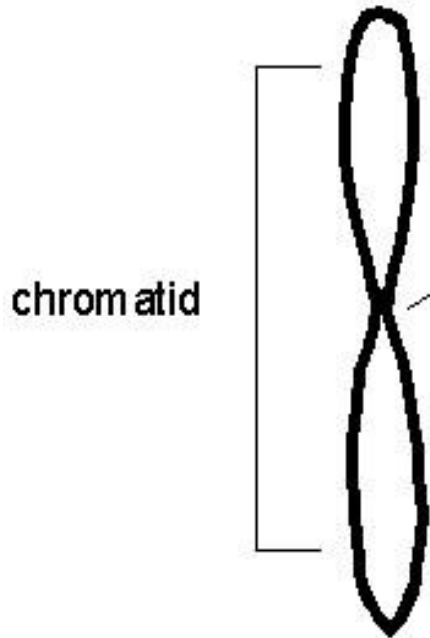
Consists of 2 parts: chromatid and centromere

Chromatin and Condensed Chromosome Structure



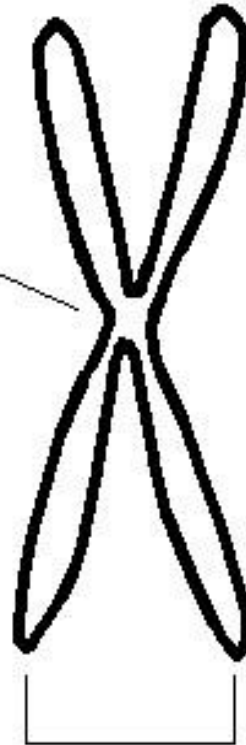
# CHROMOSOME STRUCTURE

"unduplicated"



centromere or  
primary constriction

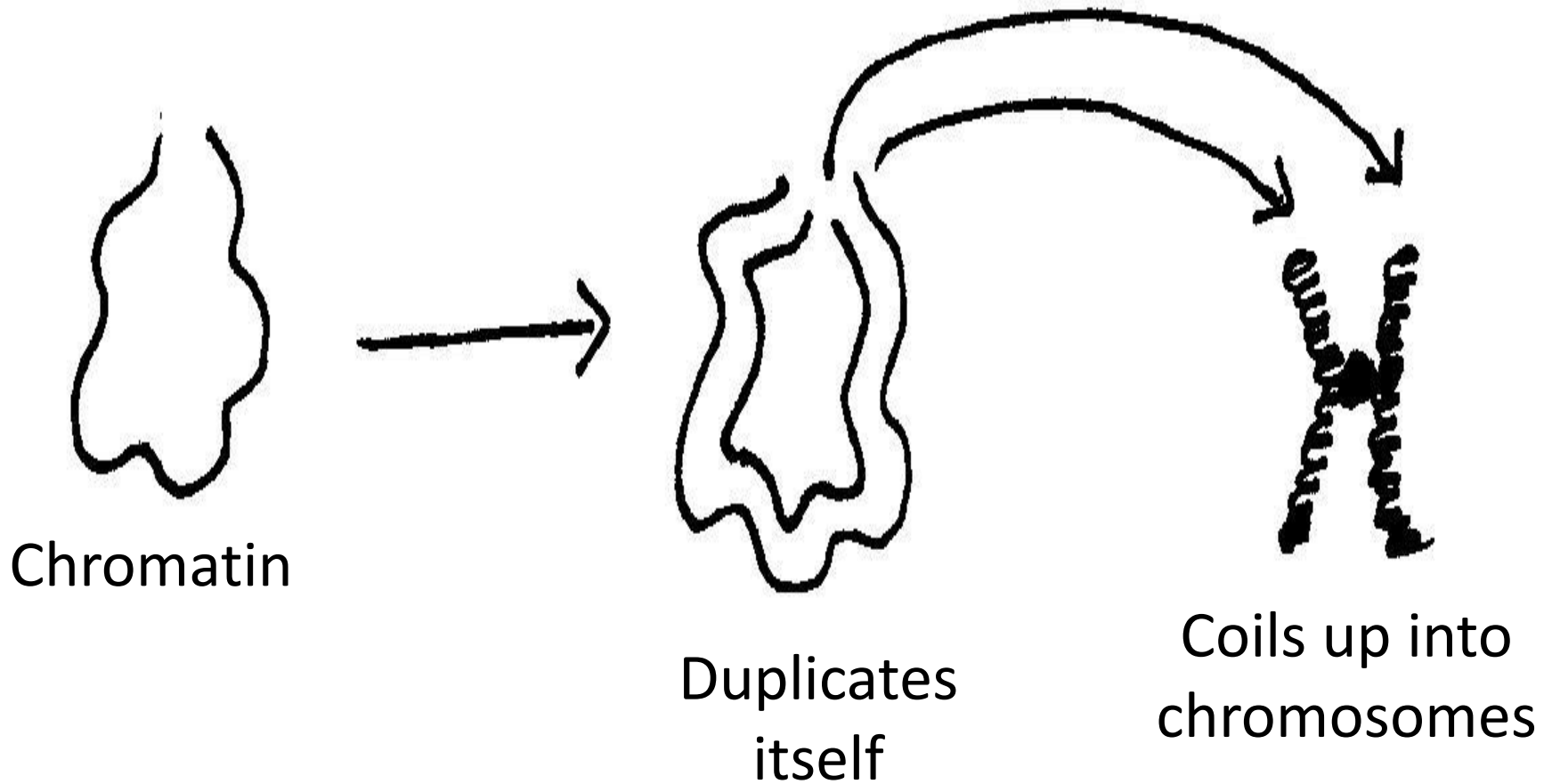
"duplicated"



- 2 identical "sister" chromatids attached at an area in the middle called a **centromere**
- When cells divide, "sister" **chromatids** separate and 1 goes to each new cell

identical sister chromatids

- Chromatin to chromosomes illustration:



Why does DNA need to change from chromatin to chromosome?

More efficient division



# Chromosome number

- Every organism has its own specific number of chromosomes

Examples: Human = 46 chromosomes or 23 pairs

Dog = 78 chromosomes or 39 pairs

Goldfish = 94 chromosomes or 47 pairs

Lettuce = 18 chromosomes or 9 pairs

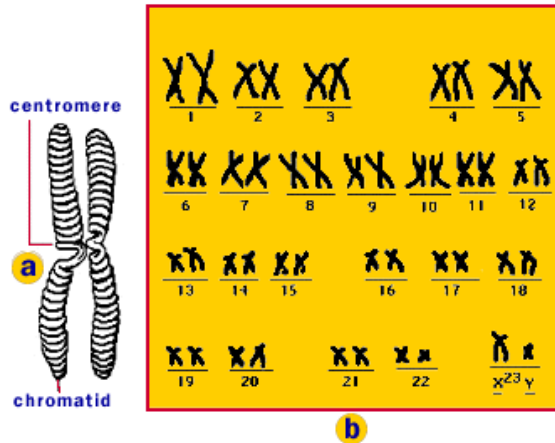




- All **somatic** (body) cells in an organism have the **same** kind and **number** of chromosomes

Examples: Human = **46** chromosomes

### Human chromosomes!



Human skin cell = **46** chromosomes

Human heart cell = **46** chromosomes

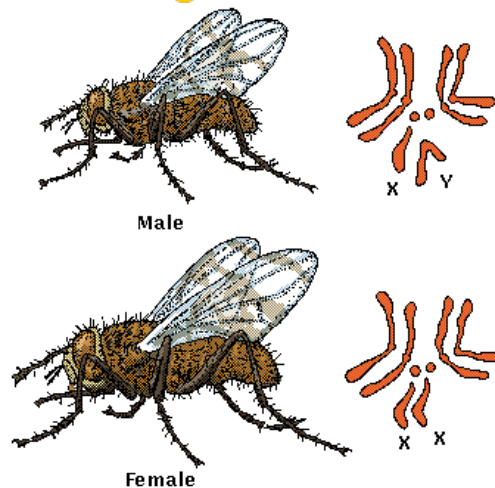
Human muscle cell = **46** chromosomes

Fruit fly = 8 chromosomes

Fruit fly skin cell = **8** chromosomes

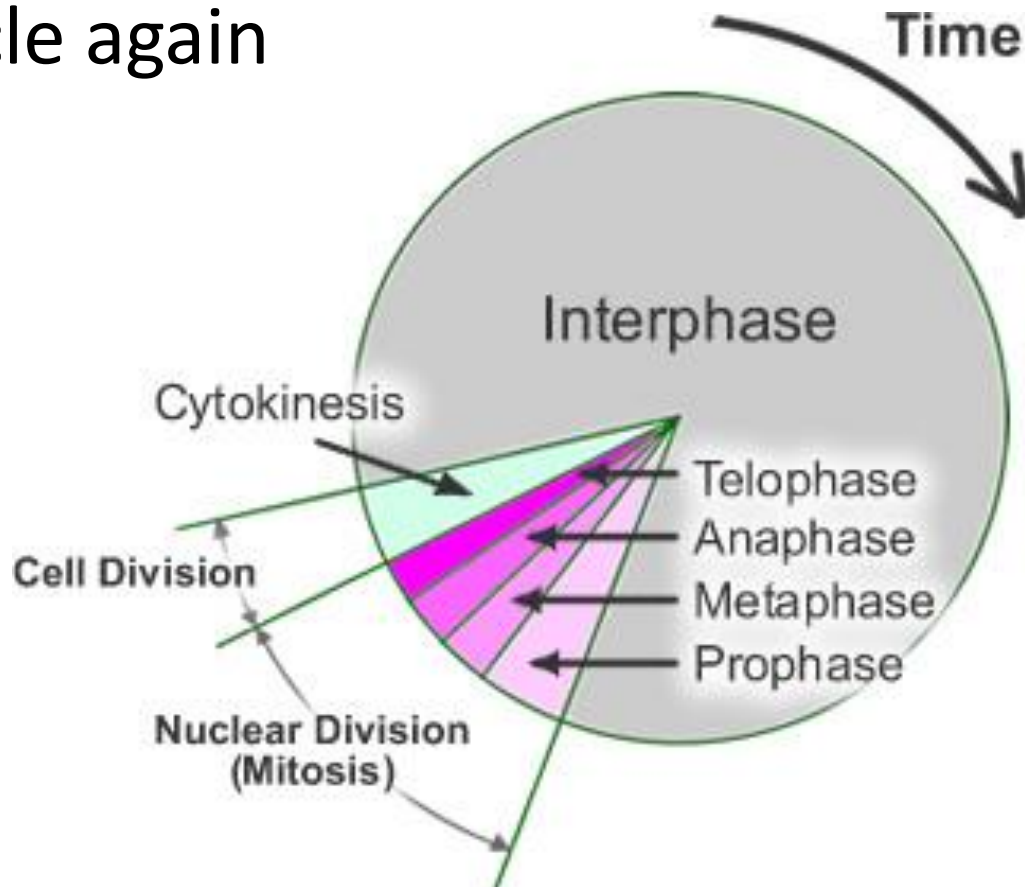
Fruit fly heart cell = **8** chromosomes

Fruit fly muscle cell = **8** chromosomes



**Cell Cycle** -- series of events cells go through as they grow and divide

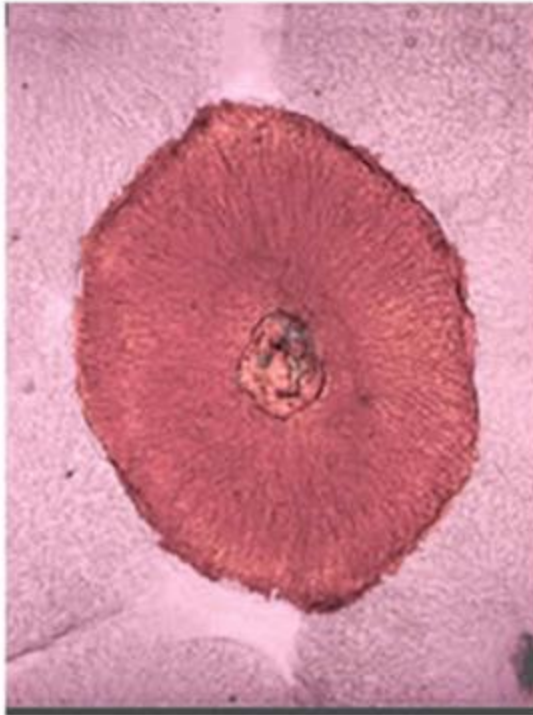
- Cell grows, prepares for division, then divides to form 2 daughter cells – each of which then begins the cycle again



**Interphase**—period of cell growth and development

- DNA replication (copying) occurs during Interphase
- During Interphase the cell also grows, carries out normal cell activities, replicates all other organelles
- The cell spends most of its life cycle in Interphase

Interphase

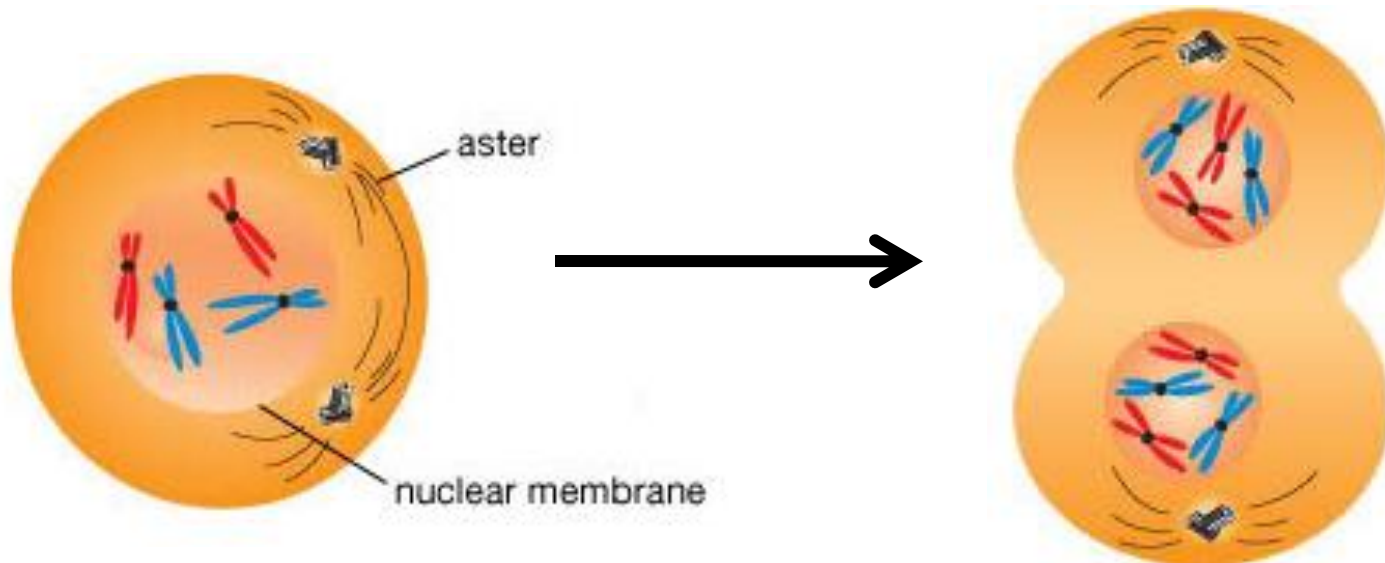




**Mitosis** – division of the nucleus into 2 nuclei, each with the same number of chromosomes

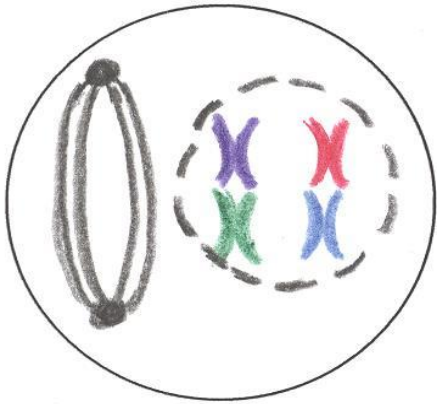
- Mitosis occurs in all the somatic (body) cells

Why does mitosis occur? So each new daughter cell has nucleus with a complete set of chromosomes

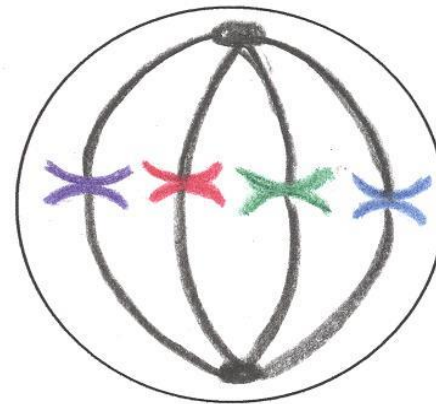


- 4 phases of nuclear division (mitosis), directed by the cell's DNA (**PMAT**)

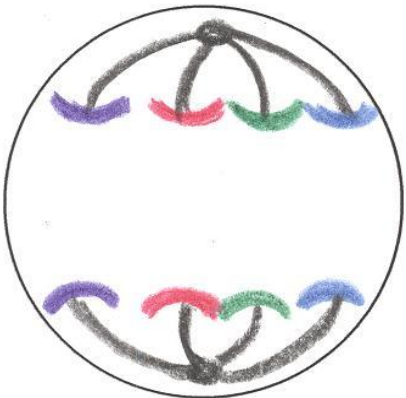
1. **Prophase**



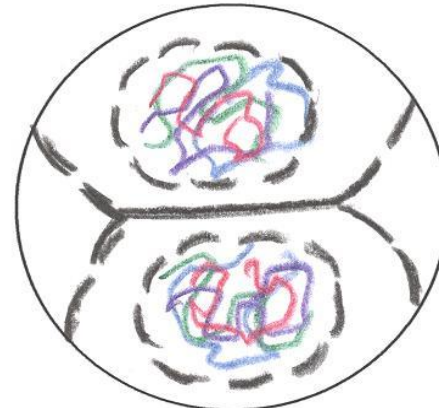
2. **Metaphase**—(Middle)



3. **Anaphase**—(Apart)

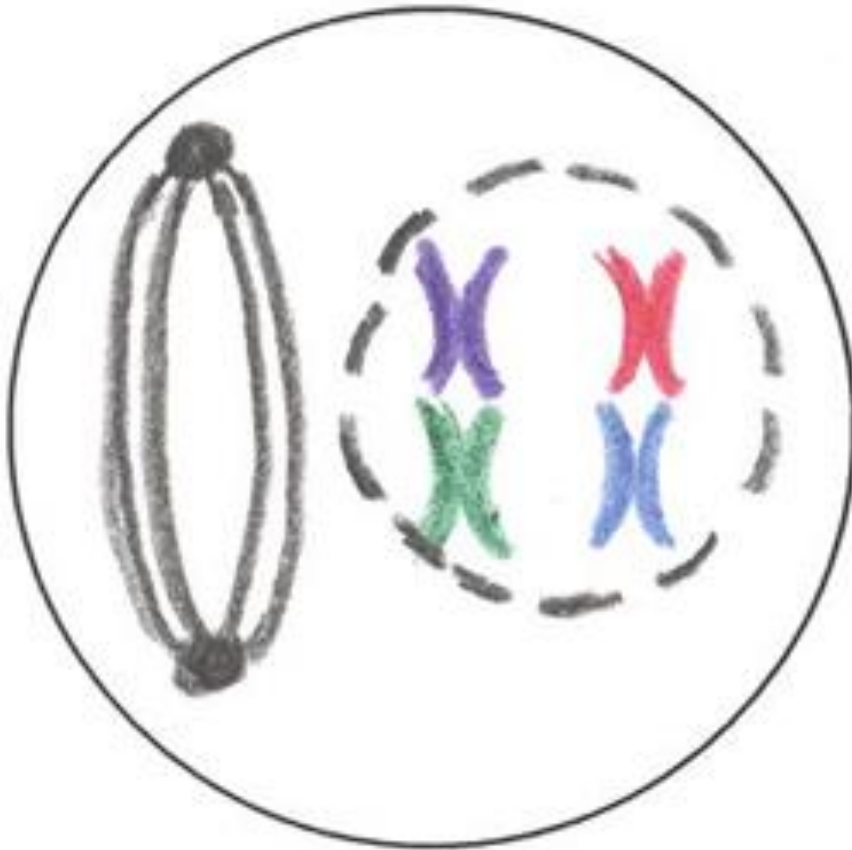


4. **Telophase**—(Two)



# 1. Prophase

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- Chromosomes coil up
- Nuclear envelope disappears
- Spindle fibers form



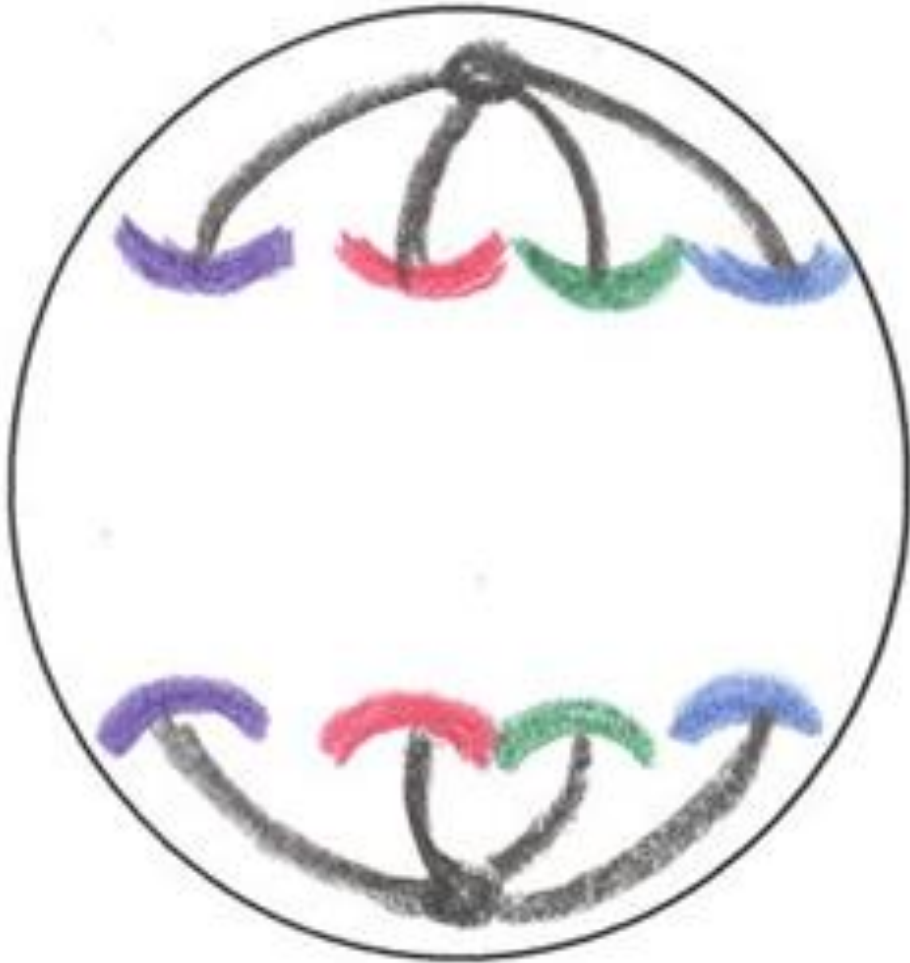
## 2. Metaphase—(Middle)



- Chromosomes line up in middle of cell
- Spindle fibers connect to chromosomes

### 3. Anaphase—(Apart)

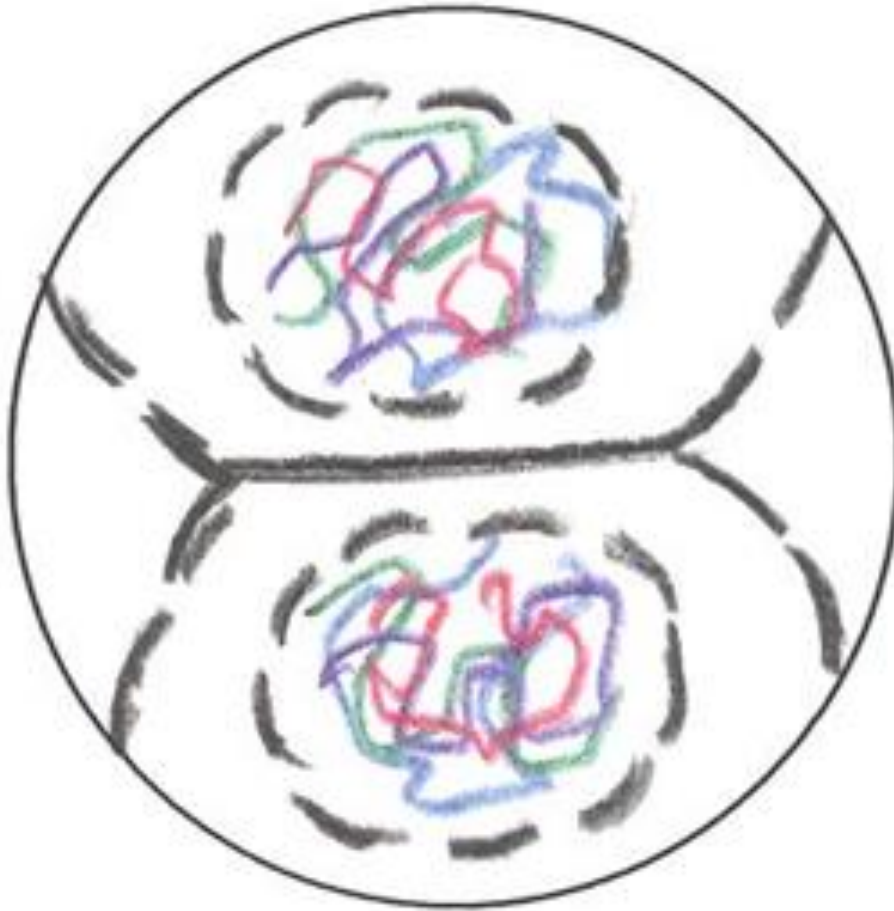
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- Chromosome copies divide
- Spindle fibers pull chromosomes to opposite poles

#### 4. Telophase—(Two)

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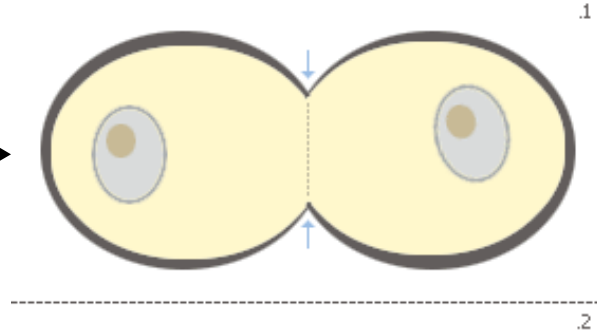


- Chromosomes uncoil
- Nuclear envelopes form
- 2 new nuclei are formed
- Spindle fibers disappear

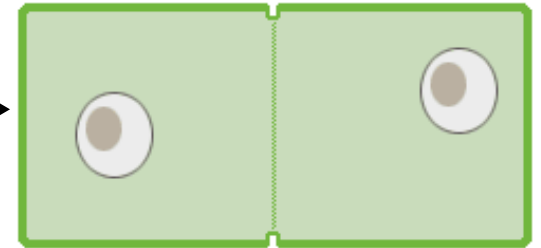


**Cytokinesis** — the division of the rest of the cell (cytoplasm and organelles) after the nucleus divides

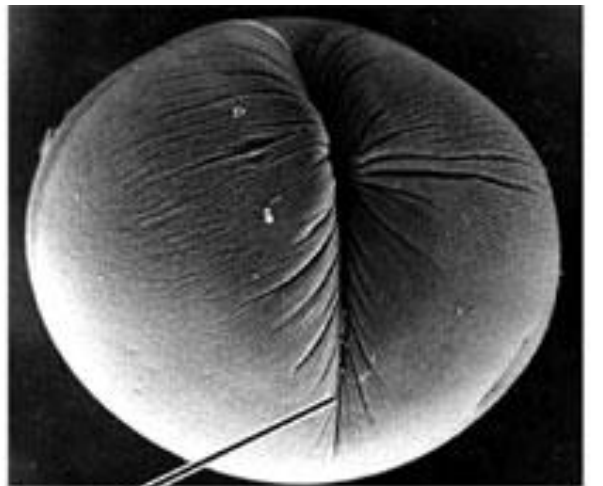
In animal cells the cytoplasm pinches in



In plant cells a cell plate forms

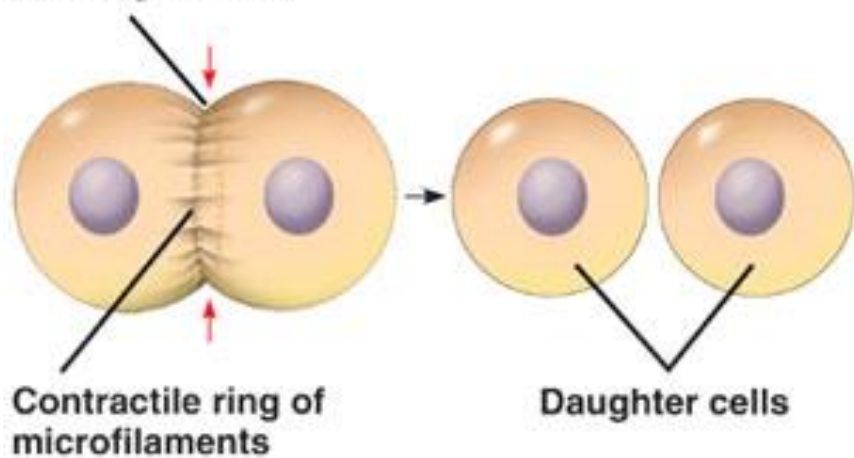


- After mitosis and cytokinesis, the cell returns to Interphase to continue to grow and perform regular cell activities



100  $\mu\text{m}$

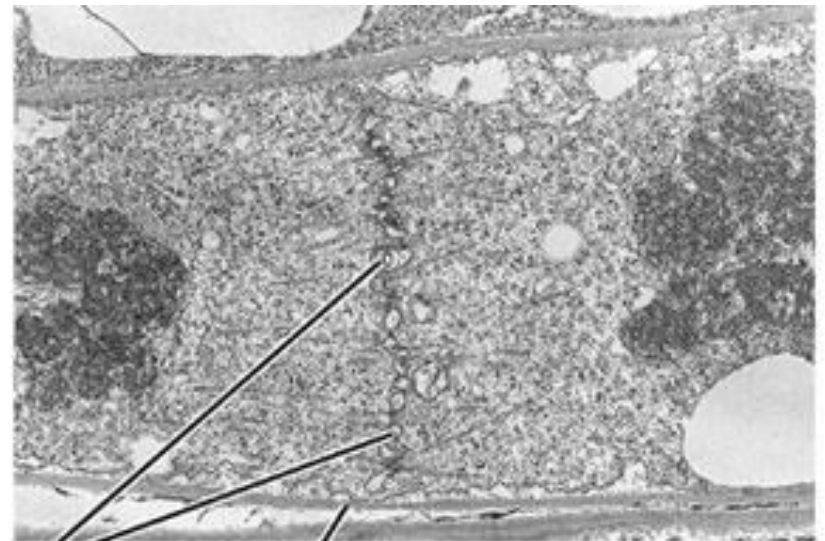
Cleavage furrow



Contractile ring of microfilaments

Daughter cells

(a) Cleavage of an animal cell (SEM)



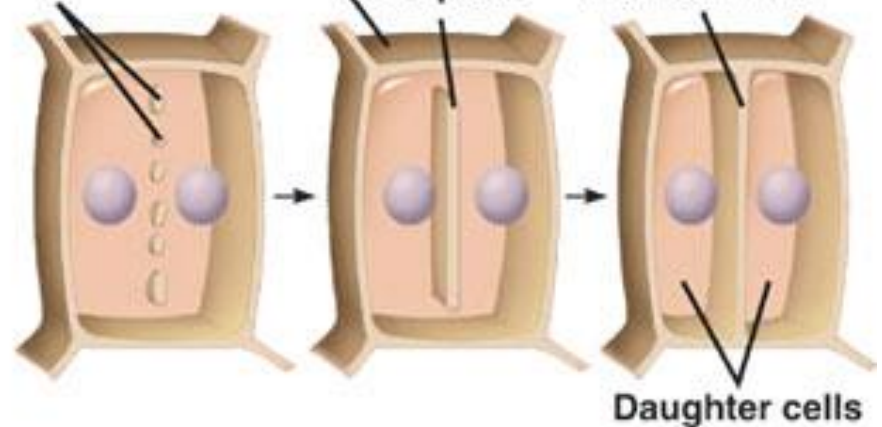
1  $\mu\text{m}$

Vesicles forming cell plate

Wall of parent cell

Cell plate

New cell wall

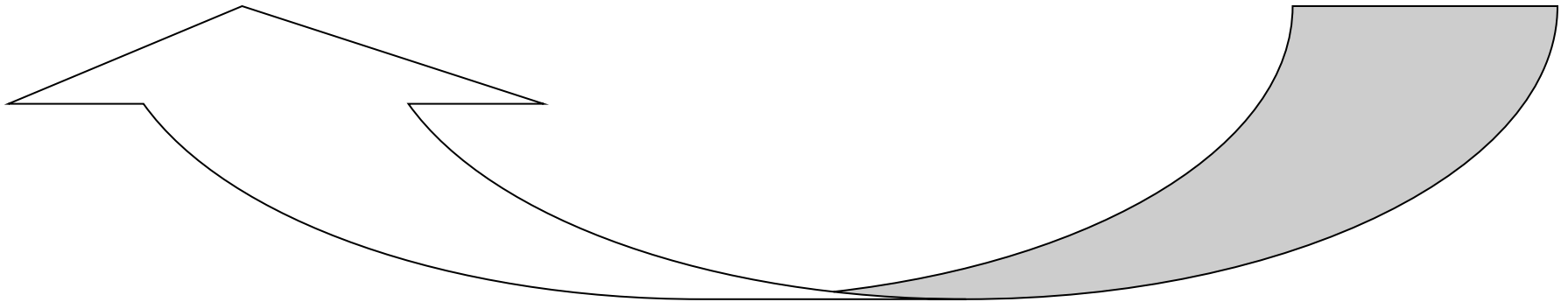


Daughter cells

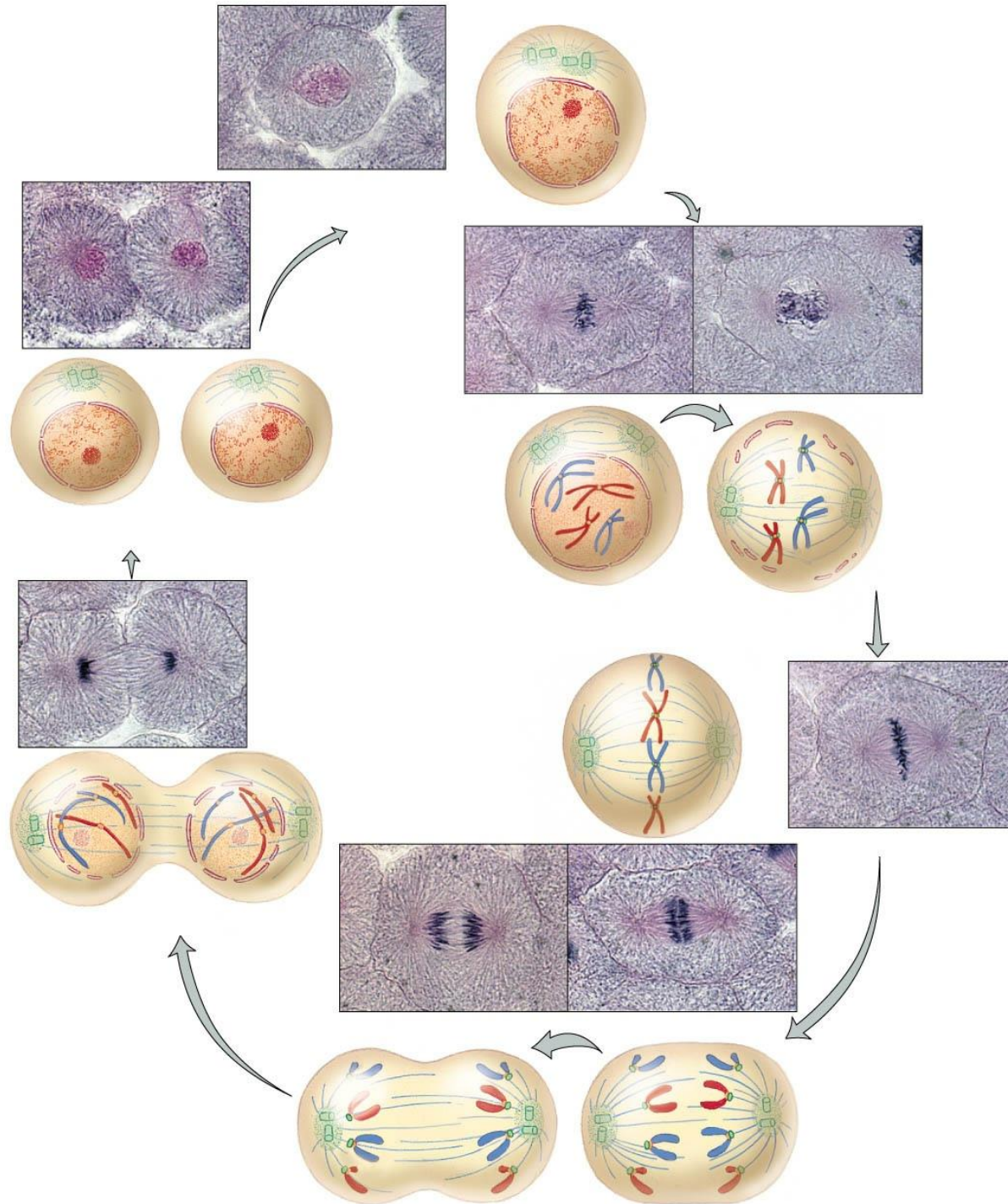
(b) Cell plate formation in a plant cell (TEM)

# Summary: Cell Cycle

Interphase → Mitosis (PMAT) → Cytokinesis



- When cells become old or damaged, they die and are replaced with new cells



<b>Phase</b>	<b>Chromosome Appearance &amp; Location</b>	<b>Important Events</b>
Interphase	DNA copies itself; chromatin	DNA replication, cell grows and replicates organelles
Prophase	Chromosomes coil up	Nuclear envelope disappears, spindle fibers form
Metaphase	Chromosomes line up in the middle	Spindle fibers connect to chromosomes
Anaphase	Chromosome copies divide and move apart	Spindle fibers pull chromosome copies apart to opposite poles
Telophase	Chromosomes uncoil back into chromatin	Nuclear envelopes reform, 2 new nuclei are formed, spindle fibers disappear
Cytokinesis	Chromatin	Division of the rest of the cell: cytoplasm and organelles